THE RIO GRANDE
SPECIAL ISSUE
Green Light
Rio Grande
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THISTLE UTAH

A Old railroad grade
B West portal tunnel through Billies Mountain, Utah
C East portal tunnel through Billies Mountain, Utah
D Diversion tunnel
E To Grand Junction
F To Salt Lake City
G To Marysvale

April 12, 1983, a wet day in a wet month in a wet year. The hills above the Spanish Fork River, near Thistle, Utah, already saturated with rain and runoff moisture, began to obey nature's law. Mud began to slip down the hillside and onto the railroad. Earth moving equipment was brought to the site to clear the track.

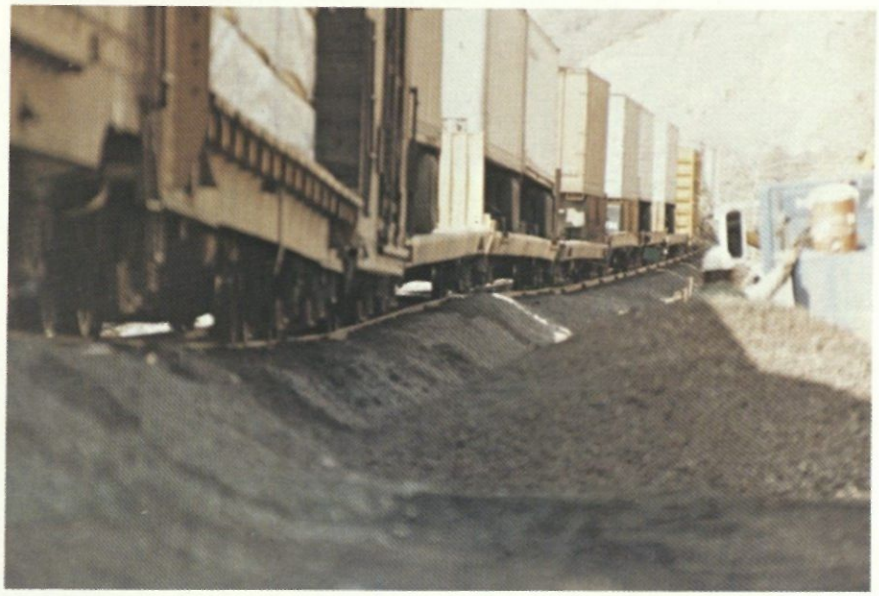
It soon became apparent that this was no ordinary Spring mud trouble. As the hillside continued to slip down, it moved the railroad with it, knocking the track out of line and buckling the grade. Due to the narrow configuration of the canyon, the slipping earth had no place to go. The tremendous pressures of the slide continued downward and across the Spanish Fork to the opposite side of the canyon, where US Highway 6 & 50 wound its way between Springville and Spanish Fork toward Provo, Utah. The east wall of the canyon was sturdier than the west side, leaving only one course for the mud to go. The massive pressures of earth caused the railroad grade, the river bed and the highway to heave.

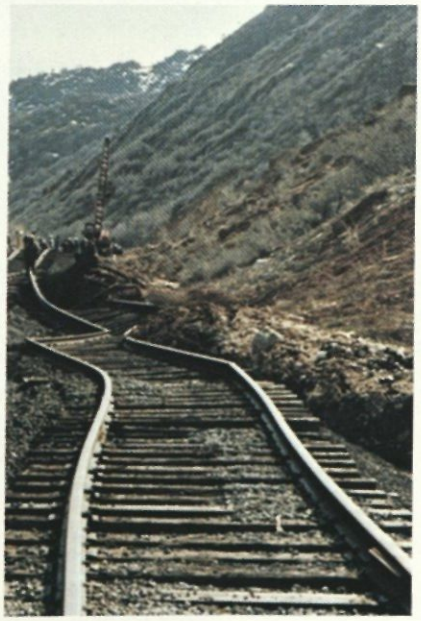
Rio Grande workers were able, for a few hours, to move mud, tamp and line track and keep the railroad open through the affected area.

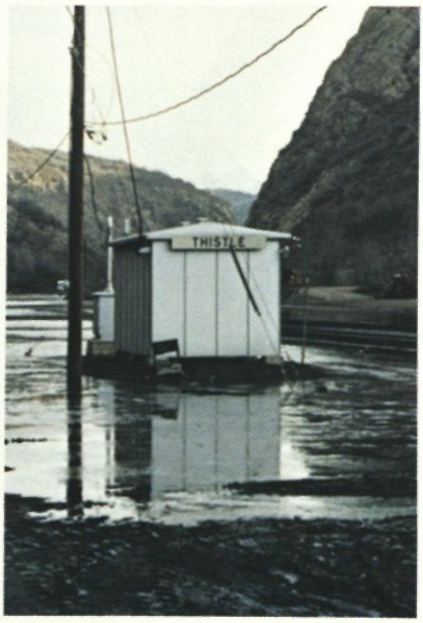
By April 14, the slide was causing the waters of Thistle Creek and Soldier Creek to back up into the tiny valley containing the town of Thistle, a small railroad yard and the railroad and highway junctions leading to the Marysvale Branch, and central Utah. More and more earth moving equipment was brought to the scene as Rio Granders and highway crews fought to keep the river channel open, but nature proved more powerful than technology and hard work. At about 8 p.m. April 14, train #17, the Rio Grande Zephyr, was "walked" through the slide area. Although no one knew it at the time, the Zephyr was on her last trip on the Rio Grande. Her replacement by the garish red white and blue of Amtrak had already been announced when the stately old silver lady left Thistle for the last time, the last train to go around Billie's Mountain.

It became obvious that the situation would continue to worsen, the residents of Thistle (among them many retired Rio Grande people), were warned of the danger of flooding. By this time, the slide was moving at about 2 feet per hour, and water was beginning to rise in Thistle Yard.

By April 17, the slide had completely blocked the flow of the river. A drainage pipe was placed in the slide in a vain attempt to keep the water flowing. Now the slide was moving about 4 feet per hour, raising the stream bed and creating what was soon to be known as Thistle Dam.







Railroad workers began moving valuable supplies and equipment, such as switch motors, block signals, and track and welding material out of the rapidly growing lake.

On April 18, the drainage pipe was removed from the ever-growing dam for fear that it would burst and cause the dam to fail. The dam did not fail, however, and by the 19th, the slide was moving 3½ feet per hour, and the water was rising at about the same rate. It soon became impossible to keep any water channel open, and Thistle, once a picturesque railroad town, sleepy and secure, was inundated, gone forever, except for the memories of her former residents and the many railroaders who had passed through.

As the lake grew, the Marysvale Branch became a victim of nature's incredible power. The Branch was covered by the lake as far as Milepost 2.65, and three bridges were completely submerged. Four more bridges were washed out between MP 2.65 and MP 8.1. Between MP 3.5 and MP 11.5, there were 9 washouts along Thistle Creek. The future of the Marysvale Branch has not yet been decided, but it is obvious that a major rehabilitation project would be necessary to restore service.

By April 20, the dam was 221 feet high, 900 feet wide, and about 1,500 feet thick at the base. The lake it created held about 64,000 acre-feet of water. By this time it was obvious that things would never be the same. A decision was made

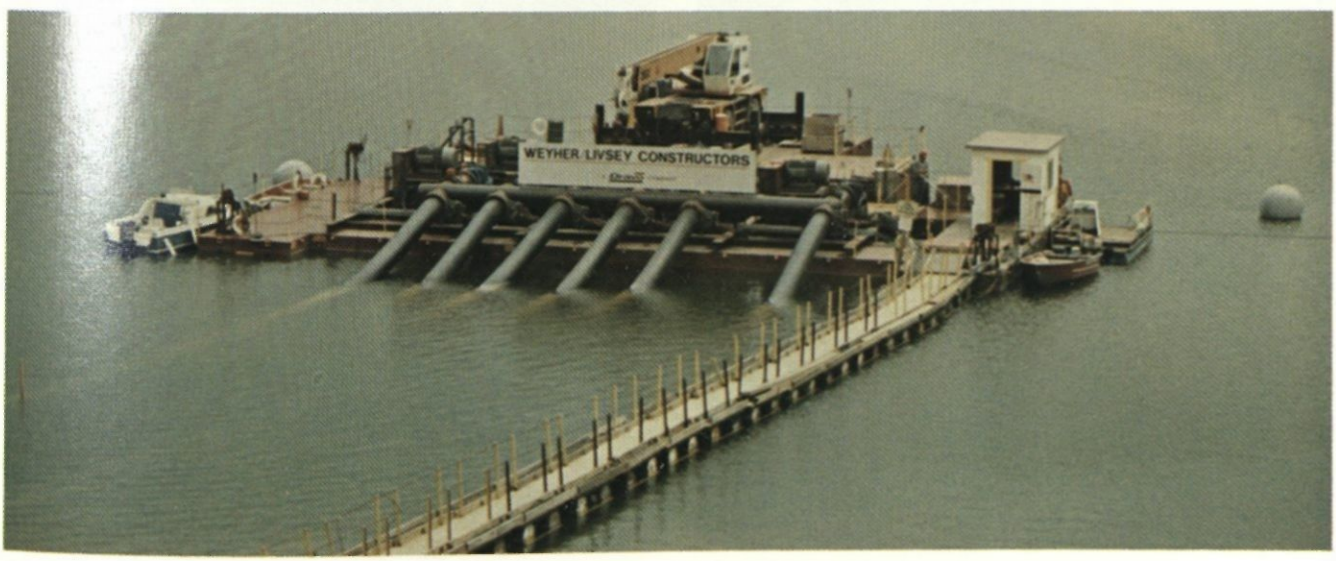
to reroute the railroad and bore a tunnel through Billie's Mountain, and preliminary survey work began immediately.

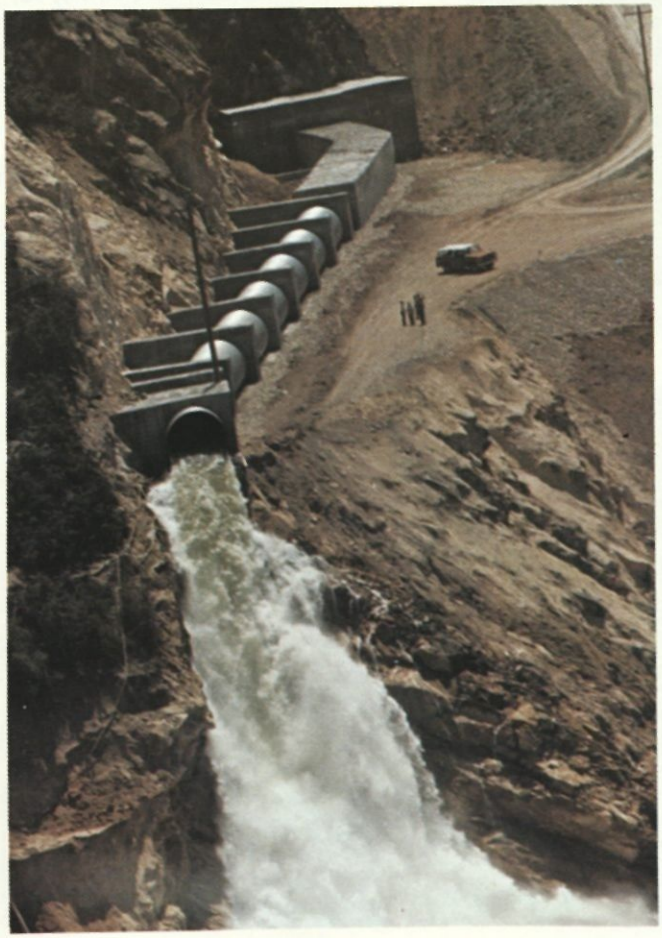
A small army descended on Thistle: contractors, subcontractors, consultants, surveyors, and railroaders. One of the first priorities was to strengthen the dam, which continued to move. Contractors moved about 500,000 cubic yards of earth to the foot of the dam to increase the thickness of the base and stabilize the structure. Had the dam failed, the town of Spanish Fork and other downstream areas, including Utah Lake would have been jeopardized.

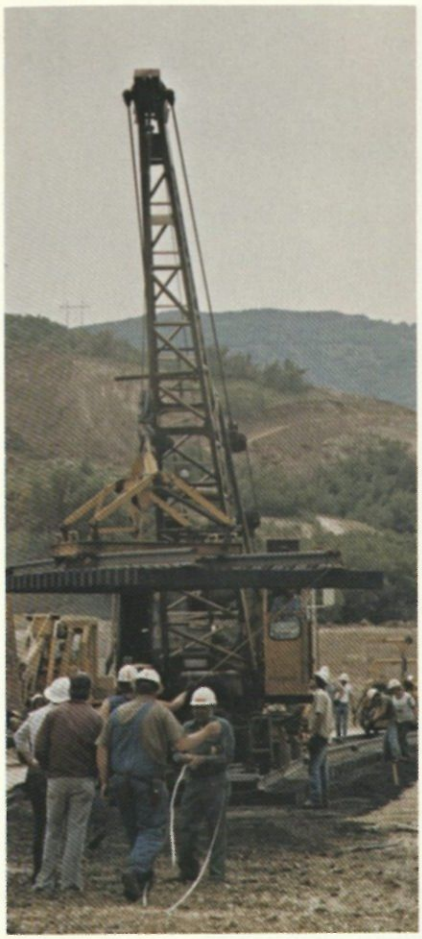
When the new alignment for the railroad was located, it became obvious that the east approach to the tunnel would have to be protected from the ever-rising waters of the lake. A diversion tunnel was therefore begun, through the face of the mountain, at the height of the dam. Work began on this tunnel and the railroad tunnel on April 26.

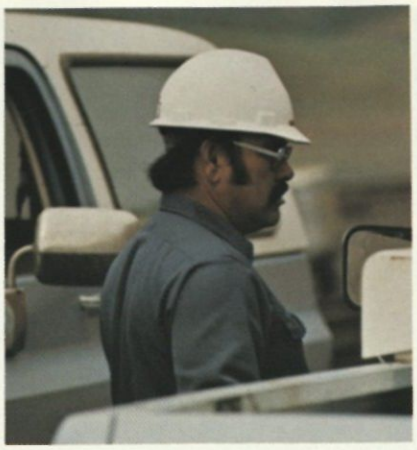
The diversion tunnel, over 475 feet long, was holed through on May 4. A 540 foot extension of 12 foot diameter steel pipe was added to the west end of the tunnel to carry water over the top of the dam. This pipe was supported by a massive concrete "cradle" and concrete collars around the pipe joints. Over 1,900 cubic yards of concrete were used in the extension and reinforcement of the Diversion structure.

This tunnel was completed on May 15, as the lake continued to rise. There had been concern that the tunnel would not be finished in time to prevent the lake from overtopping the dam but, thanks to the extraordinary efforts of all concerned, this did not happen. Water did not flow through the diversion tunnel until May 18. At its peak, the diversion tunnel carried well over 2,000 cubic feet of water per second. The downstream side of the dam was reinforced with rock to control erosion caused by this enormous amount of water.









The U.S. Army Corps of Engineers constructed a barge which held huge pumps feeding hoses laid down the west face of the dam to help drain the water. This effort contributed only about 200 cubic feet per second against an estimated peak inflow of 2,800 cfs.

As work began in earnest on the new railroad grade, Rio Grande men began to salvage everything possible from the old main lines. Track was removed in panels to be used in construction of the new line. Even the ballast was picked up to be reused on the new grade. The old bridge at MP 684.04 was dismantled and removed, and was later used to replace a bridge washed out at the Jordan Narrows.

At about the same time work began on a massive box culvert which would carry the new line over Diamond Fork Creek. Over 1,900 cubic yards of concrete were needed to build the 4-box 12 by 12 foot structure. The path of Diamond Fork was diverted and water flowed through the new structure on June 10.

Loss of its main line did not put the Rio Grande out of business, as many yard employees know. Virtually all traffic from Rio Grande's connections at Denver, Pueblo and Ogden was diverted over the tracks of another railroad through Wyoming. This led to a dramatic increase in business on the Denver-Pueblo line as traffic which normally moves through Pueblo and Ogden via Grand Junction was rerouted through Denver's North Yard. Yard, clerical and mechanical forces faced many challenges to keep this business moving without congestion, and everyone involved performed in a competent and thoroughly professional manner.

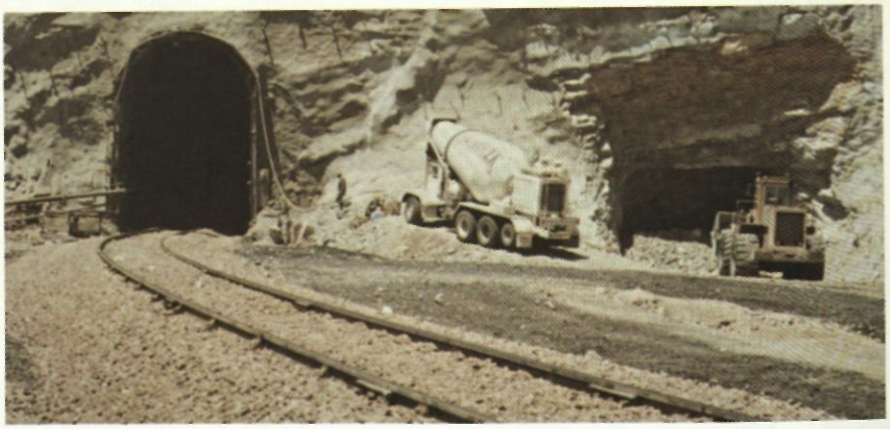
As work progressed on the new line and tunnel, Rio Grande men and contractors amassed some truly impressive statistics. To grasp the enormity of this project, bear in mind that the new line is 6.15 miles long, and all but the 3,000 foot tunnel is double track. About 2½ miles of the Westward main track on the east side of the tunnel is new welded rail. The balance was laid in panels, some new, some salvaged from the old line.

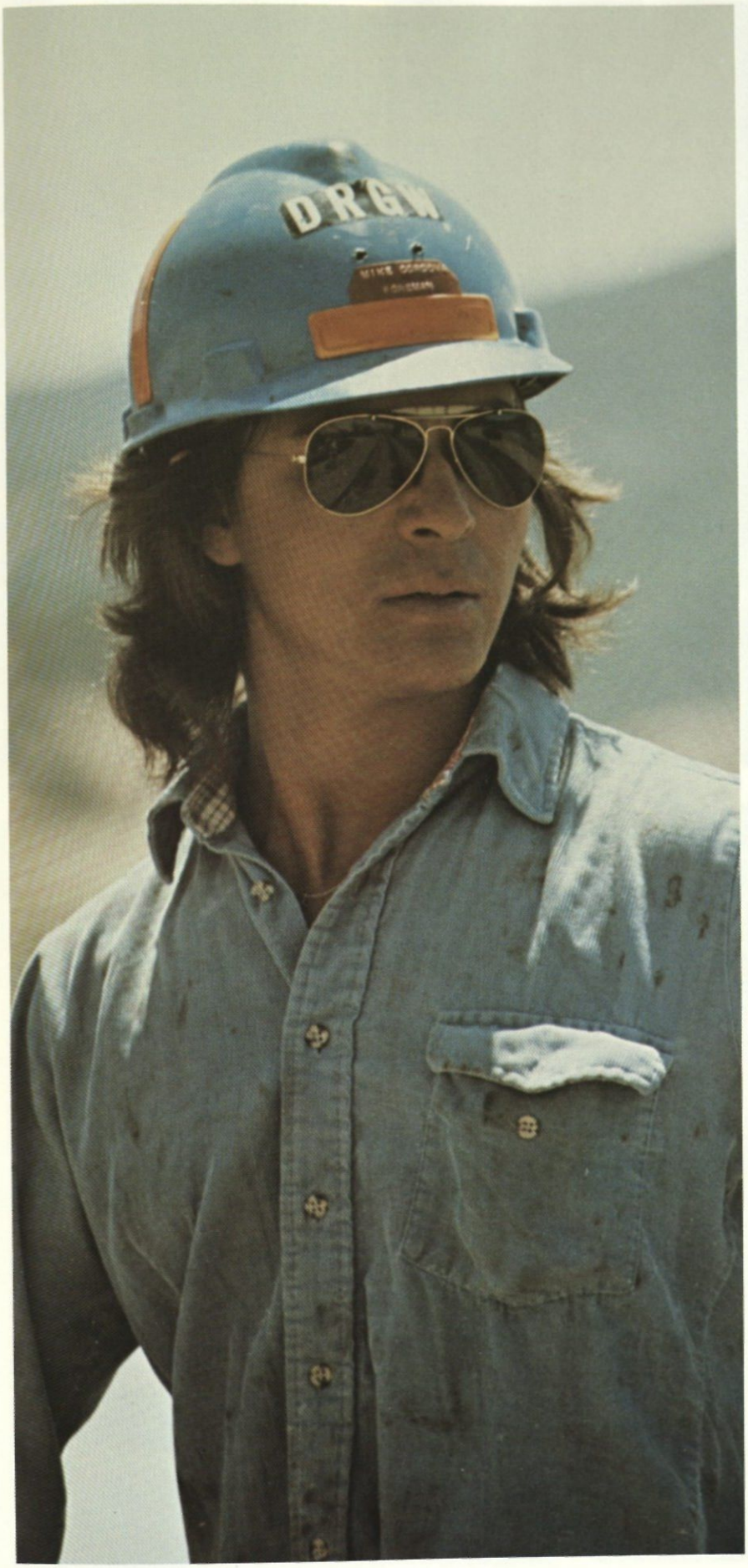
Over 1.67 million cubic yards of earth were moved in the preparation of the new grade. The largest cut, known as the "Big D" cut, is 275 feet high and about 1,000 feet long.

At its peak, the Thistle Project employed over 600 people. Prime contractors were H-E Lowdermilk Co. of Helper, Utah, and Morrison-Knudsen Co. of Boise, Idaho. These contractors mobilized over 100 pieces of equipment on extremely short notice. This kind of response, along with the determination, hard work and expertise of the construction crews, and the well known abilities of the Rio grande Maintenance of Way forces completed a multi-year project in less than 3 months. Expert geotechnical advice was provided throughout by Shannon and Wilson, consultants.

At 3:12 p.m. July 4, 1983, D&RGW extra 3107 east, the 246-04, was the first through train to enter the tunnel through Billies' Mountain, only 82 days after #17 made her last trip west.

The Rio Grande is justifiably proud of this achievement, unequaled in the railroad industry. The lion's share of the credit goes to the people in the trenches: heavy equipment operators who moved inconceivable amounts of dirt; section men who ate slag dust and wound dump doors; signal men who bonded thousands of rail joints; miners who dug a 17 by 29 foot hole through a mountain; yardmasters, switchpersons and clerks who orchestrated the diversion of thousands of cars. Their abilities and the teamwork which is always in evidence, are the qualities which make the Rio Grande without equal in performance and reliability.





Reprinted from the eM-Kayan, Magazine of Morrison-Knudsen Company.

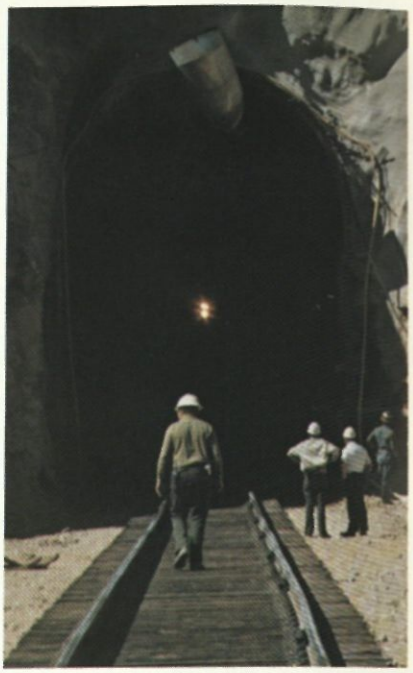
ON THE WEEKEND of April 15, Spanish Fork Canyon in central Utah was closed when a mammoth slide containing millions of cubic yards of saturated clay, mud and rock lumbered off a steep mountainside, creating a dam-like barrier, 220 feet high, across the canyon.

This huge slide severed major railroadand highway routes, dammed up the Spanish Fork River and has formed a lake that, as of mid-May, measured more than three miles in length. Nearly 60,00 acre-feet of water fill the lake, which completely inundated the railroad town of Thistle, as well as submerging numerous farms and ranches along the canyon floor. Because of the slide's slow, but relentless movement into the canyon, emergency authorities had ample time to evacuate residents from the rising waters, thus avoiding loss of human life. However, the economic losses may run in the hundreds of millions of dollars. The devastation could possibly reach even greater proportions if the unstable landslide gives way. This would send a huge wall of mud and water crashing into the valley below, threatening the lives of thousands of people living in several communities at the mouth of the canyon.

As it has done oftentimes during emergencies in other areas, Morrison-Knudsen Company quickly responded to assist in combating the effects of the disaster under contracts awarded by Rio Grande Industries, parent company of the Denver & Rio Grande Western Railroad, and by the State of Utah.

Located southeast of the city of Provo, the canyon has been a major avenue of commerce though the rugged Wasatch Range of the Rocky Mountains ever since it was pioneered as part of the Old Spanish Trail two centuries ago. So named because of this heritage, Spanish Fork Canyon provides a corridor for the double tracked east-west main line of The Denver & Rio Grande Western Railroad. This vital artery carries large volumes of freight, nearly half of which is coal from mines in eastern Utah and western Colorado, for industries in Utah and via transfers to other railroads, for a host of other industrial customers throughout the West. In addition, the canyon is also traversed by U.S. Highway 6-50 that links eastern Utah with the state's urban centers around Salt Lake City.

First answering calls from the D&RGW, M-K quickly marshalled a fleet of nearly 100 major units of equipment and a work force of more than 300 people. The task: help re-route the submerged stretch of the railroad on the canyon floor to a new location along the mountainside high above the slide area and safely away from the encroaching lake. This involves driving a 3,106-foot-long horseshoe-shaped tunnel, 21 x 29 feet in size, through blocky sandstone above the slide's right (northeast) abutment, as well as excavation and preparation of nearly three miles of double-track roadbed extending from the tunnel's upstream portal. Roadbed construction from the downstream portal is being performed by other contractors. Rail laying and ballasting will be performed by the railroad itself.



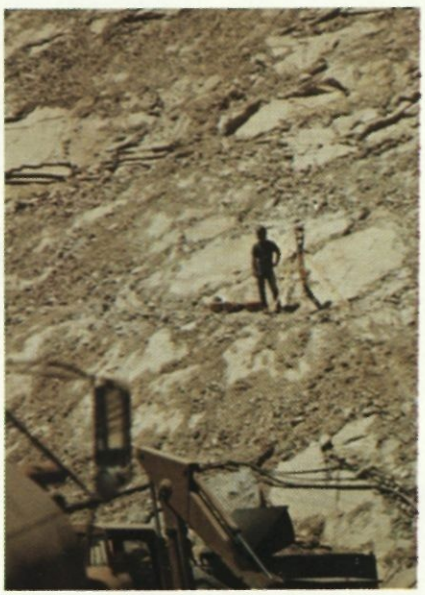
In addition, in less than a week's time, M-K excavated a flood-water diversion tunnel around the right abutment just below the slide's crest to discharge water as the impoundment rose toward the top of the slide. This tunnel measures 476 feet in length with upstream dimensions of 21 x 8 feet tapering to 10 x 8 feet at the downstream portal. Water from the tunnel will be discharged to the original streambed far below the slide, through a 12-foot diameter culvert installed by other contractors. On May 18, the reservoir reached the tunnel entrance and water began flowing through the discharge system. Also, to help assure the slide is not breeched by any sudden runoffs from the heavy snows in the surrounding mountains, the U.S. Army Corps of Engineers is supervising other contractors engaged in lowering the reservoir by means of pumping. This involves barge-mounted pumps working at the slide's upstream face, lifting the water through a series of pipes up and over the barrier to the downstream river channel.

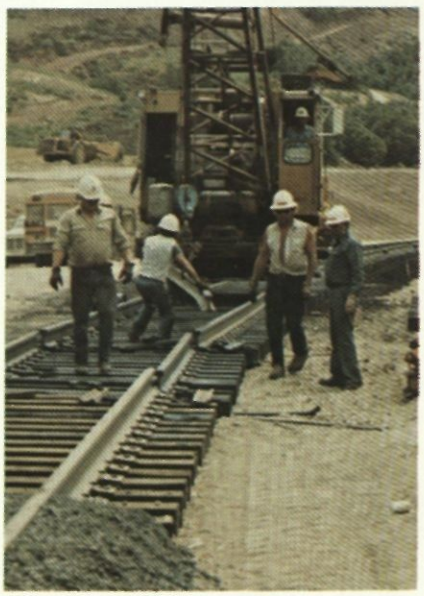
Work by M-K on the single-track railroad tunnel (a second single-track tunnel is planned for the future by the railroad) is advancing around the clock, seven days a week from both portals. Multi-deck drill jumbos are being employed at both headings to drill the tunnel face, followed by blasting and removal of the fractured rock by eight-yard low-profile loaders. As the tunnel crews advance, the bore is being buttressed by steel ribs every three to five feet along with timber lagging. Once the tunnel is opened, its walls and arch will be coated with pneumatically placed concrete. As of May 16, more than 175 feet of the tunnel had been opened, with completion expected in early July.

Large-scale, pioneering civil work also continues without surcease on the new railroad roadbed leading to the upstream tunnel portal. To accomplish this phase of the project, dozens of dozers, scrapers, compactors, trucks, backhoes and loaders are at work, many of them hurried to the site in but a few days from M-K operations as far away as Canada and Texas. Their work involves cutting away precipitous hillsides and filling of sloping valleys to create a newly aligned roadbed that will measure 39 feet in final width. In all, excavation of nearly 800,000 cubic yards of material is required for the roadbed.

A third tunnel — this one intended to drain the impoundment and permanently relocate the Spanish Fork River around the slide area — will be opened under a contract awarded in late May by the State of Utah's Department of Public Safety. Still undergoing final design at the time of this writing, the drainage scheme likely will involve driving a 2,000-foot-long tunnel from near the level of the riverbed on the downstream side of the slide, around the northeast abutment, connecting with an inclined tunnel, or a shaft, along the hillside on the upstream side of the slide.

Detached roof tops bob randomly in the murky waters behind the massive slide. The tops of once-stately cottonwood trees barely reach above the surface in some areas, and occasionally, a telephone pole, undermined and set free by newly formed "Thistle Lake," shoots to the surface like a submarine-borne missle. All are grim reminders of the devastation wrought by the massive mud slide and the lake it now impounds. Add to this the economic losses of The Denver & Rio Grande Western Railroad, whose trains now must make a 1,000-mile long detour to deliver their shipments of coal and other commodities, the Thistle slide becomes perhaps one of the worst natural disasters in Utah history.





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On July 4, less than three months after a major slide blocked rail and highway routes through Utah's Spanish Fork Canyon, the Denver & Rio Grande Western ran its first train through a new bypass tunnel excavated nonstop by Morrison-Knudsen Co., Inc., Boise.

D&RGW officials held a special Independence Day celebration and then ran five coal trains through the 3,106-ft bore, ending the long and costly detour around the 4-million-cu-yd slide. Jack K. Lemley, M-K group vice president, heavy and marine group, says the original schedule called for holing through on July 19. Good rock, fast mobilization of jumbos and other equipment plus the assembling of experienced crews who had worked together before helped to beat that timetable, he says.

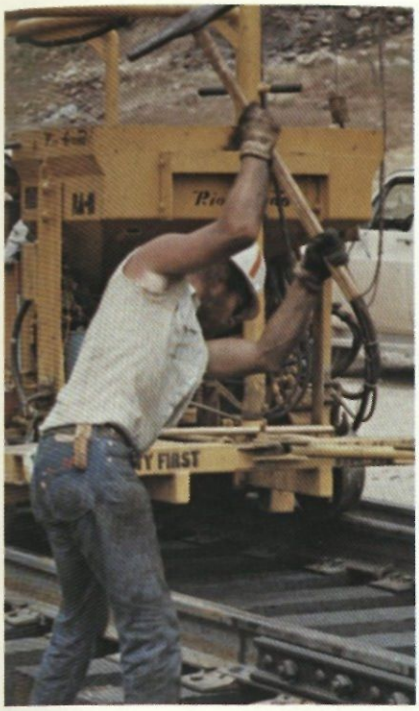
The first drilling on the tunnel started April 30. As the rock was removed, steel sets were placed on 4 to 7-ft centers. The railroad's track-laying crews followed close behind, finishing a day after the bore was holed through on July 3. "It was almost an engineering miracle," says Edward H. Waring, chief engineer for the railroad.

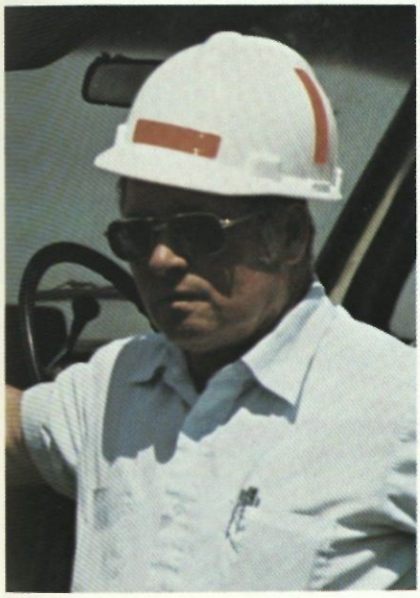
With the first 21 x 29-ft single-track tunnel open, M-K crews still have to excavate another rail tunnel and a drain for the reservoir as part of the cost-plus emergency work. The job will cost the railroad some $40 million by the end of the year, Waring says.

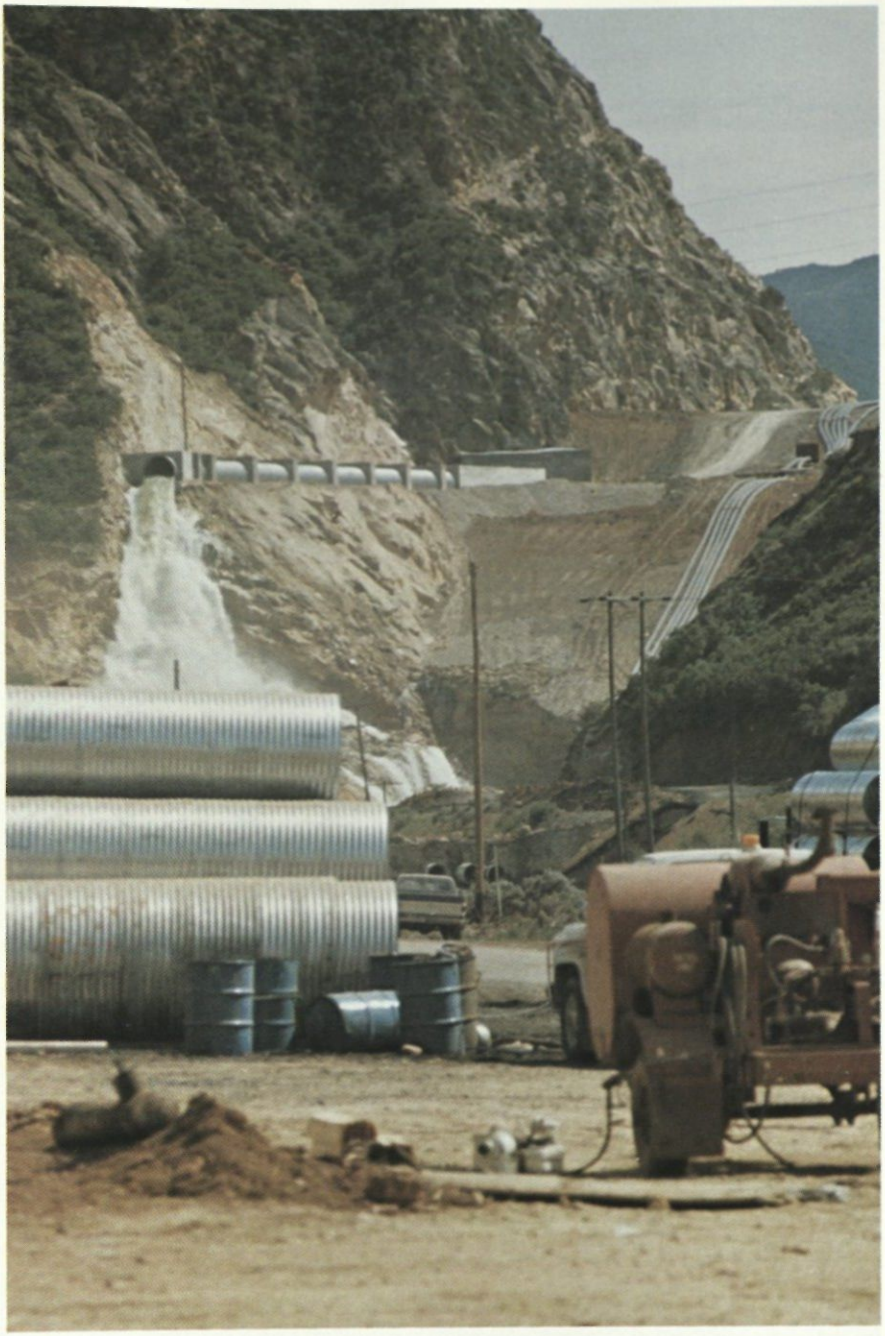
Without taking a breather last week, crews moved the six-boom jumbos a few yards over at each heading to get started on the second rail tunnel. The tunnel into an abutment of the slide dam is due to be completed near the end of September. Both bores will be lined after that.

Unique drain. Downstream from the 1,000-ft-long dam formed by the April 14 slide, another M-K team is excavating a 2,550-ft-long tunnel at streambed level that will drain the 188-ft-deep lake trapped behind the dam. The scheme designed by Woodward-Clyde Consultants, San Francisco, is believed to be a first. A 180-ft shaft wil be raise-bored at the end of the tunnel and then benched out gradually from the top to form a slot that will be lowered in stages to empty the lake by October. The tap is estimated to cost $2.4 million.

At its peak, the lake was 204 ft deep and stored some 80,000 acre-ft behind the slide dam. The embankment was originally about 180 ft high but had to be raised another 40 ft. The reservoir has been drawn down 16 ft to 52,000 acre-ft, reports Robert L. Morgan, director of dam safety for the state Department of Natural Resources. The lake is presently







being drained through a 476-ft-long 8 x 10-ft tunnel M-K crews carved out in a week's time shortly after the slide to protect the planned rail tunnels against flooding. The short diversion tunnel at 5,170 ft elevation, 30 ft below the rail tunnel is carrying 400 cfs into the channel below the dam.

As of early July, M-K crews had advanced about 1,500 ft into the 14-ft-dia drain tunnel. The design calls for driving the tunnel to a point about 200 ft from the lake, then raise-boring a 20-ft shaft into the mountain upstream of the dam and about 20 ft from the water's edge explains Woodward-Clyde project engineer John A. Bischoff. Gates will be installed at the intersection of the tunnel and shaft.

Blasting the notch. The area between the shaft and the lake's shoreline will be gradually benched out in 10-ft lifts, staggered between two channels so that the lake level is dropped 5 ft at a time and all work can be done in the dry, Bischoff says. When the benches are complete, the slot will be about 60 ft wide at the top and 30 ft wide at the bottom, he adds. The tunnel will be lined with concrete and the rock walls will be supported by rock bolts.

In blasting sequences, the shaft will be allowed to fill with water to minimize blasting impact on the gates, a trash basket will be lowered to catch debris, and each lift blasted out.

Woodward-Clyde engineers looked at two other alternatives besides the slot technique. The few lake taps that have been done in Europe have been made through tunnels driven underneath a lake bed through rock and opened to the lake by blasting out a plug, Bischoff says. While such a tap was considered for Spanish Fork, the 40-ft-deep layer of slide debris in the lake would have complicated the procedure.

The consultants would have preferred to make the tunnel 1,500 ft longer so that it could have intercepted the lake on a near horizontal grade upstream from the dam, Bischoff says. But state officials vetoed this plan as slower and some $1.5 million more expensive. They are anxious to drain the lake as soon as possible. "We consider the dam unsafe," says Morgan.

Meanwhile, construction of a new 6½-mile highway segment to provide a new route around the slide started in mid-June under a $22.7-million contract held by W.W. Clyde Co., Springville, Utah. Completion of two of the four lanes is scheduled for Dec. 1. The other two lanes will be added during next year's construction season.

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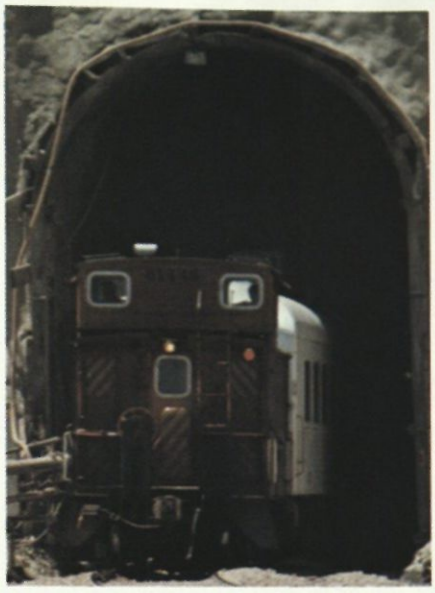

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